2017

ROOST MONITORING

By Heather Kaarakka

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Wisconsin Bat Program
Bureau of Natural Heritage Conservation
Wisconsin Department of Natural Resources
Bat "condo" sketch by Heather Kaarakka

WISCONSIN BAT PROGRAM

WISCONSIN DEPT. OF NATURAL RESOURCES

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A silver-haired bat spotted on the base of a tree by a volunteer in southeast Wisconsin. Photo: M. Peters

Little brown bats happily using the new bat houses at the I-90 bridge site.

A background on bats

Bats are found on every continent except Antarctica, and have diverse diets including bats that eat fruit, insects, pollen, scorpions, fish and even blood.

Bats are cryptic and commonly misunderstood animals, but they are important to almost every ecosystem on the planet. Bats provide many ecosystem services including pollination, seed dispersal and **pest-insect control** . In fact, it has been estimated that bats save farmers in North America upwards of $22 billion in pest control services every year, and bats' services are worth $1 billion each year to the corn industry alone[1,2] .

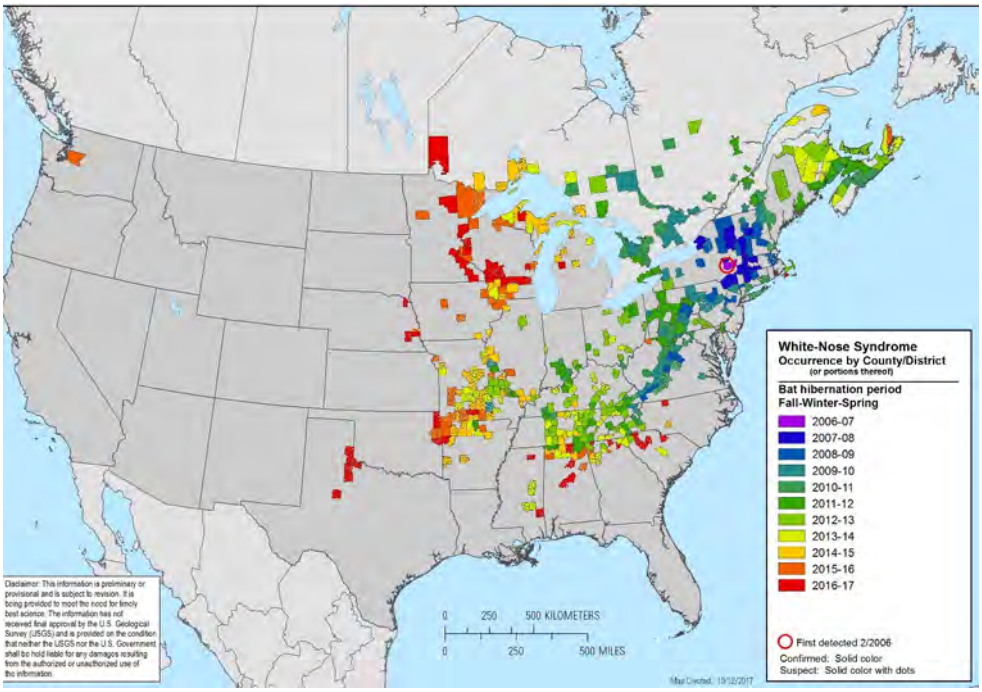
A single little brown bat can consume up to 1,000 mosquito-sized insects in one hour!

Bats are important to Wisconsin's agricultural industry, but some species are under threat of extinction from a deadly fungal disease called white-nose syndrome (WNS). In 2006, a fungus, later named *Pseudogymnoascus destructans,* was documented growing on the muzzles and wings of hibernating bats in a New York cave. The disease causes mass mortality in hibernating bats, and population die-offs of 90-100% are not uncommon. WNS has spread to 31 states and five Canadian provinces, and over 6 million bats have died from WNS since 2007. Unfortunately, WNS was confirmed in Wisconsin in March of 2014. Sites in twenty four counties are infected in the state as of fall 2017.

A roost refers to the area where bats congregate to rest during the day. Bats need these safe places to sleep and raise their young. Summer roosts can be trees, bat houses, attics, barns and other buildings, bridges and other secret places.

With the threat of WNS looming, the Wisconsin Bat Program (WBP) began efforts in 2010 to locate both summer and winter colonies of bats. Landowners and volunteers have helped WBP locate and monitor over 150 summer **bat roosts** in the state since 2010. These monitoring efforts by citizen-

scientists helped WBP establish baseline information about where bats are, what type of roosts bats use, and how many bats inhabit each roost over the summer before declines from WNS are seen in the state. Now that the disease is here, these efforts continue to help WBP learn about impacts from WNS on the summer landscape.



Currently, Wisconsin has twenty four counties where sites are infected with WNS or have the fungus causing the disease. Map: Lindsey Heffernan PA Game Commission

Wisconsin's bats

Wisconsin has eight species of bat, but only two are most likely to use bat houses or man-made structures- the **little brown bat** and the **big brown bat.** Little brown bats tend to use hot places in south-facing bat houses and barns, while big brown bats prefer cooler conditions. The warm temperatures help females bats gestate quickly and the newborn bats (called pups) mature quickly. These two species will also form large colonies in summer and bats often return to the same roost yearly. The other six species in the state are solitary or form much smaller colonies, use mostly trees in summer, and do not often return to the same roost sites making them much harder to find and monitor. As a result, WBP volunteers monitor primarily little brown bat and big brown bat roosts but in 2015, **eastern pipistrelles** were reported roosting on a porch in St. Croix County. Since then, other colonies have been reported and several pipistrelle colonies are currently monitored.

Eastern pipistrelles are the state's smallest bat and are also called the tri-colored bat.

Bats in Wisconsin return to summer roosts from winter habitat in April and May. By late May and June, most of the colony is present at the site. Bat pups are born in early June and are flightless for four to six weeks. In mid-July, bat roost monitors often observe an increase in bats because the juveniles begin flying. In August, the adults begin to leave their summer roost to go to winter habitat where they will forage and mate at the entrances of caves and mines. Females delay fertilization until they emerge or return in the spring.

Little brown bats peek out of a roost in a crack in a shelter building at Perrot State Park.

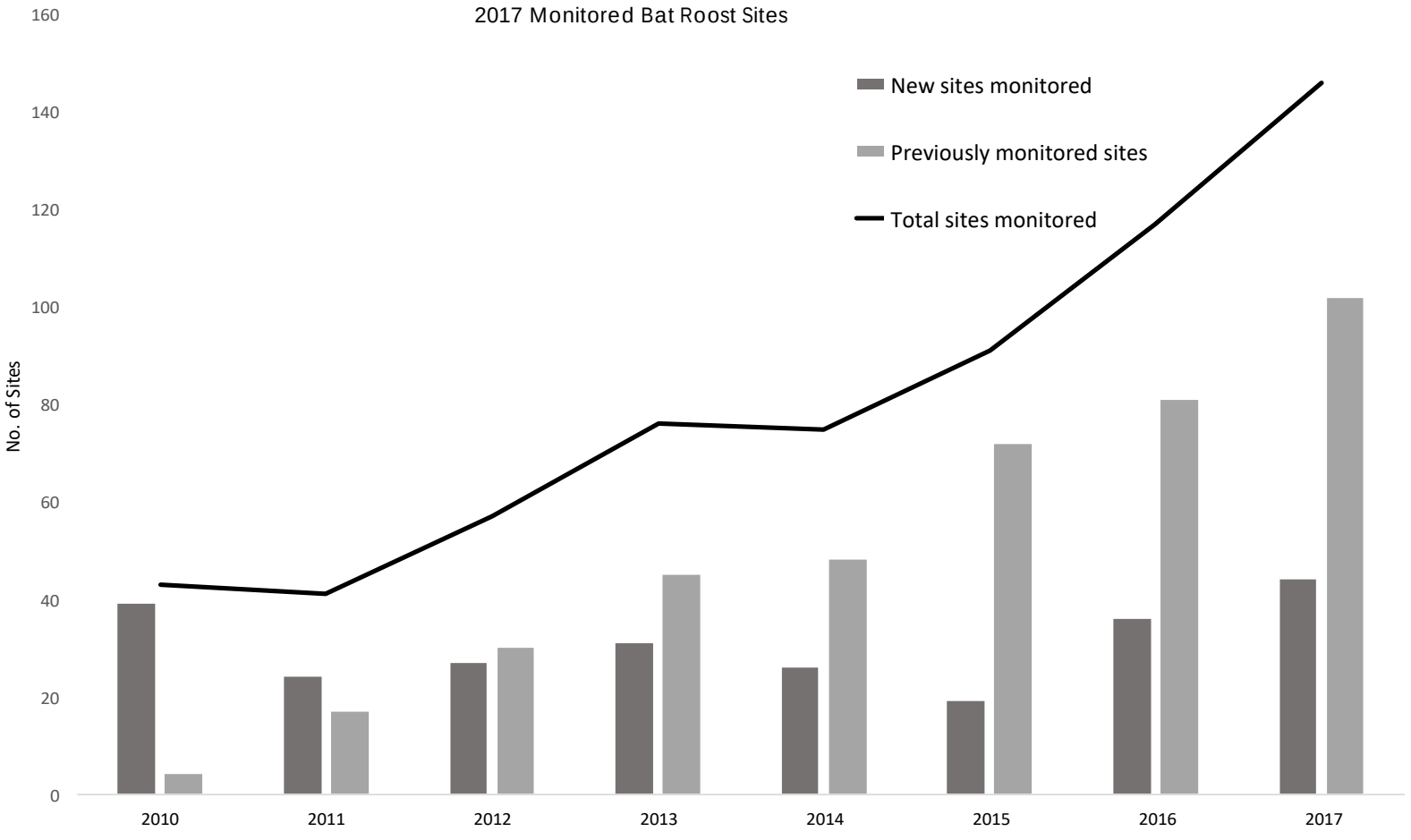
Roost monitoring in 2017

This year, 185 volunteers conducted over 400 emergence surveys in 56 counties from March to October. The project continues to grow and volunteers monitored 145 roosts in summer of 2017 (up from 116 sites in 2016) including 44 newly reported roost sites!

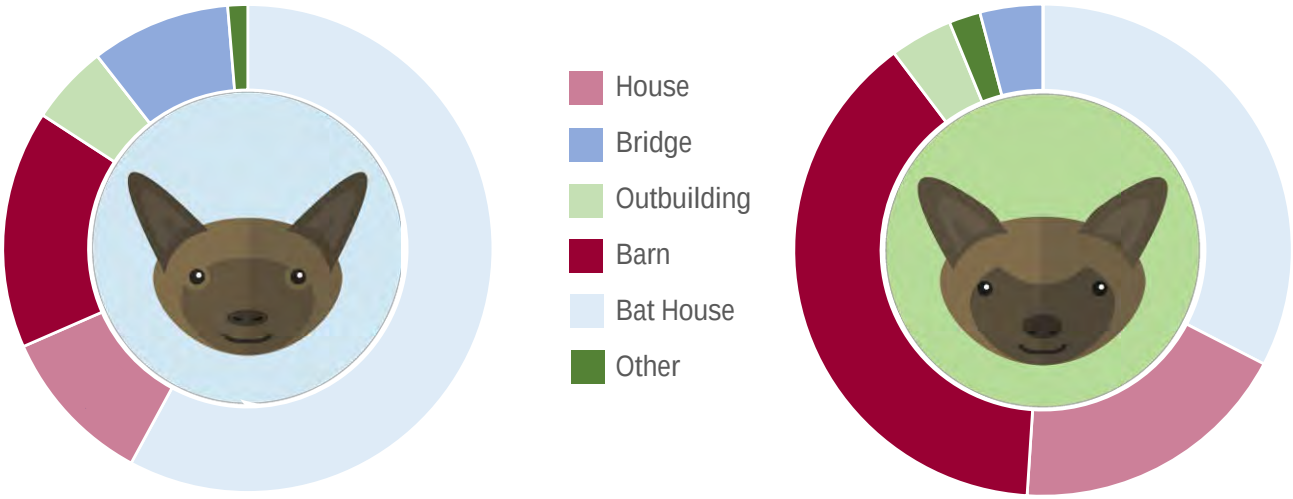
In 2017, the **total little brown bats** counted- **11,406–** was down by more than 50% from 2016 when 23,607 were counted. The **total number of big brown bats** counted **-3,573–** was up since 2016. Total numbers counted are estimated from the highest counts at each site. 35 eastern pipistrelles were counted in 2017. Little brown bat roosts comprised 53.1% of monitored sites in 2017. Big brown bats were counted in 33.8% of the sites and the remaining sites house eastern pipistrelles, both little brown and big brown, or it is unknown which species is housed.

Above: a newly discovered colony of big brown bats in a shed at Perrot State Park.

Below: a graph depicting the number of sites monitored every year through the roost monitoring project.



Bat species by roost type

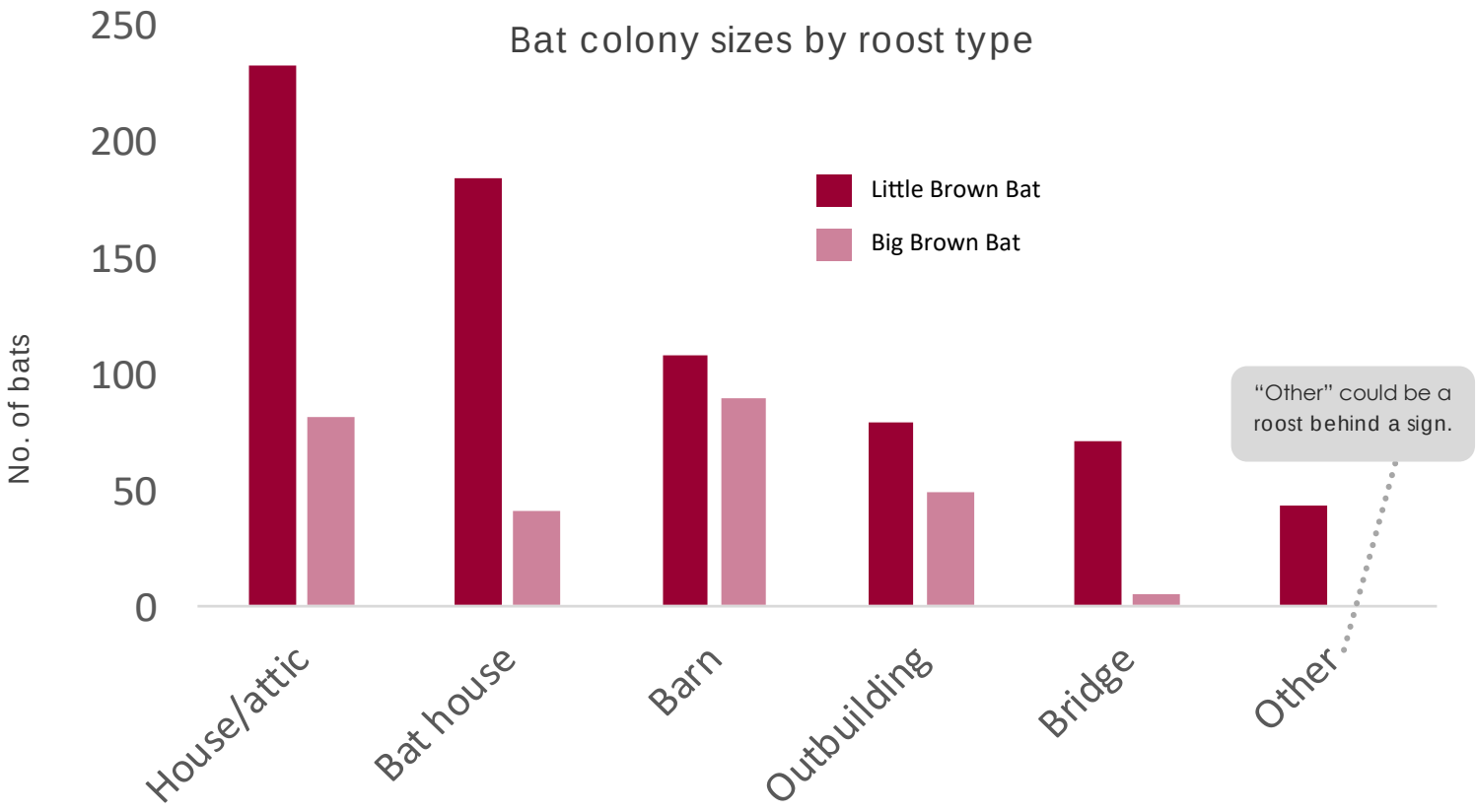


Little Brown
77 roosts

Big Brown
49 roosts

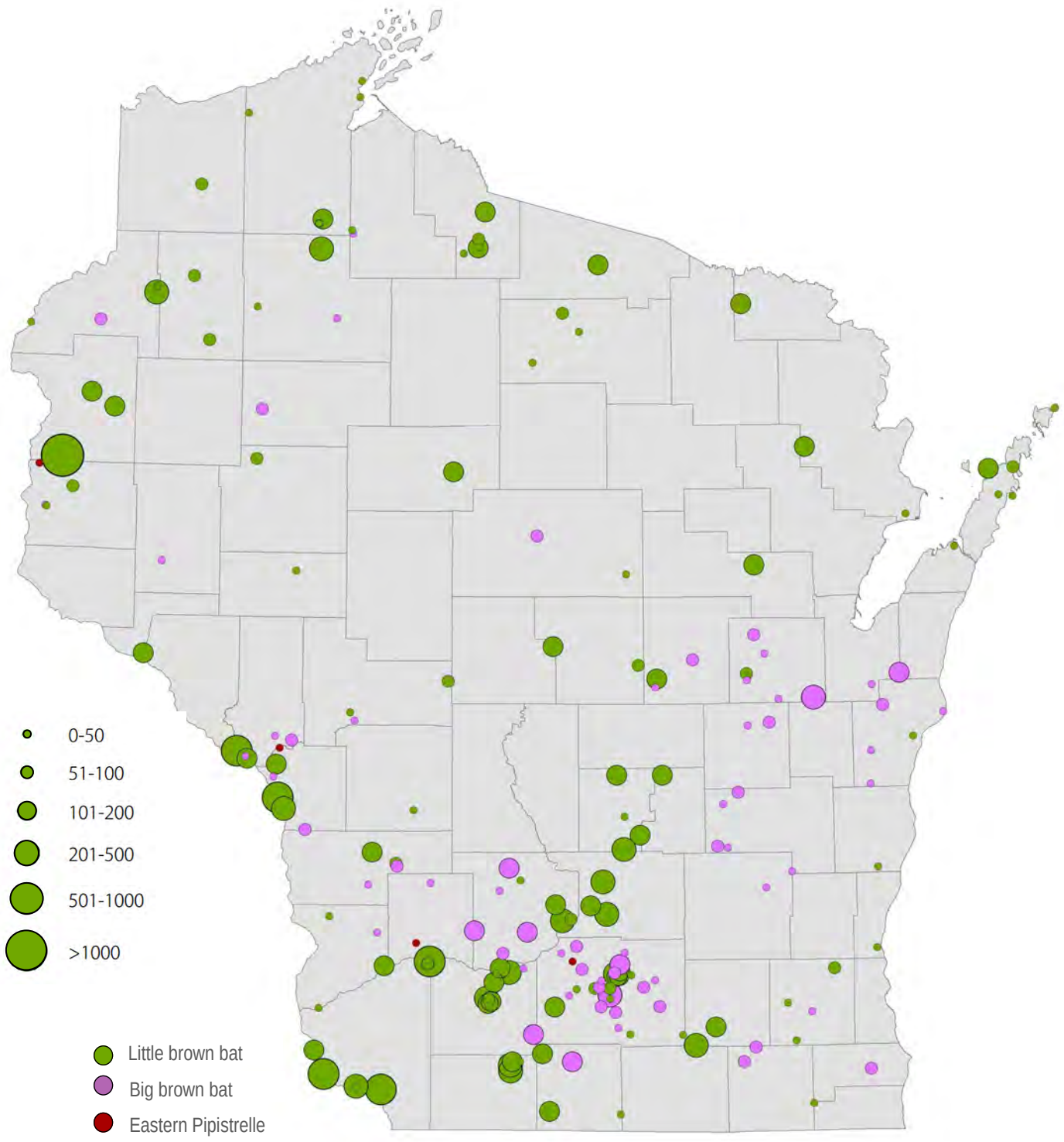
***Above**: sites of each species are split by type of roost. Little brown bats were found most often in bat houses, and big brown bats preferred barns.*

***Below:** Colony sizes for each species are sorted by the average of highest population size found in each roost type. Of note– results from 2016 had several average little brown bat roost colony sizes by type between 300 and 600 bats. Below for 2017, the highest little brown bat average colony size barely reached 240 bats.*



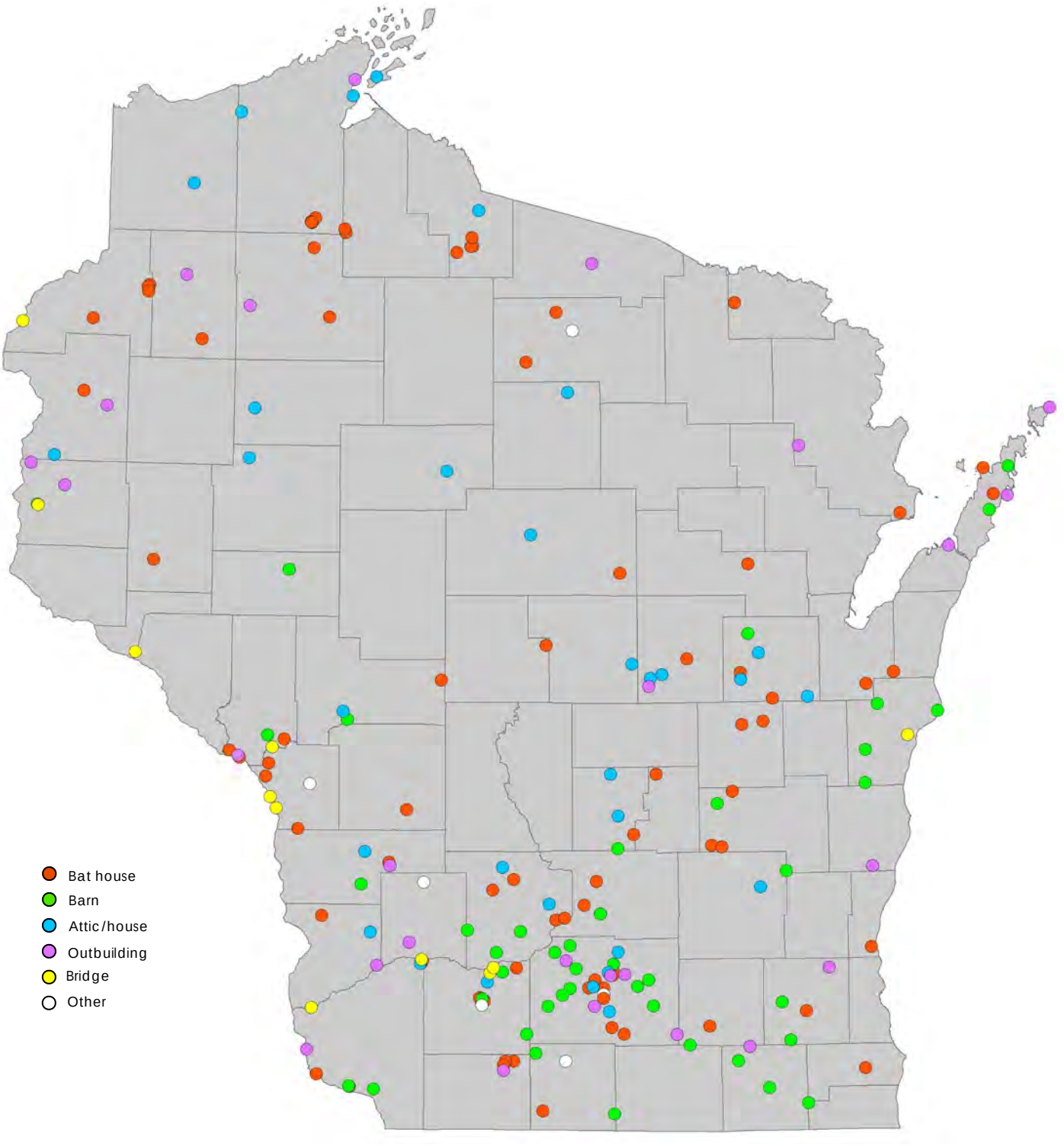
Bat roosts by size

The below map depicts the distribution of monitored bat colonies and their sizes in Wisconsin, where purple indicates big brown bat colonies green, little brown bat colonies, and orange, eastern pipistrelle colonies. Size of the dot indicates average size of the population at the roost.



Bat roosts by type

This map depicts the distribution of monitored bat colonies by type of roost. Color of the dot indicates whether the bats roost in a bat house, attic, outbuilding, barn, bridge or other.

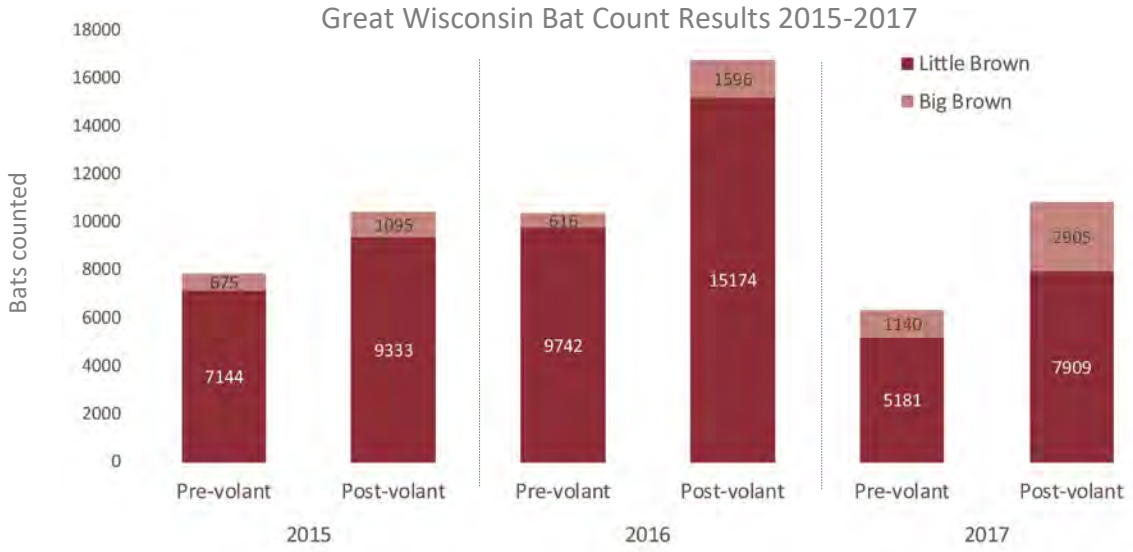


Third annual Great Wisconsin Bat Count

WBP created a statewide bat count, similar to the Christmas Bird Count.

In 2015 we began the Great Wisconsin Bat Count, with the goal of counting as many roost sites as possible on a single weekend. Two statewide counts are completed yearly the first weekend in June during the pre-**volancy** period, and a weekend in late July during the post-volancy period to help investigate reproductive success of the monitored colonies. All statewide counts have been great successes. Volunteers counted at 71 roosts in June, counting a total of 6,333 bats. In late July, volunteers surveyed 77 roosts and counted 10,839 total bats!

Volancy refers to flight. A pre-volant count is conducted before pups are able to fly and a post-volant count is after juveniles can fly on their own.



Volunteers wait for bats to emerge at Yellowstone Lake State Park during the post-volancy Great Wisconsin Bat Count

Bats in bridges

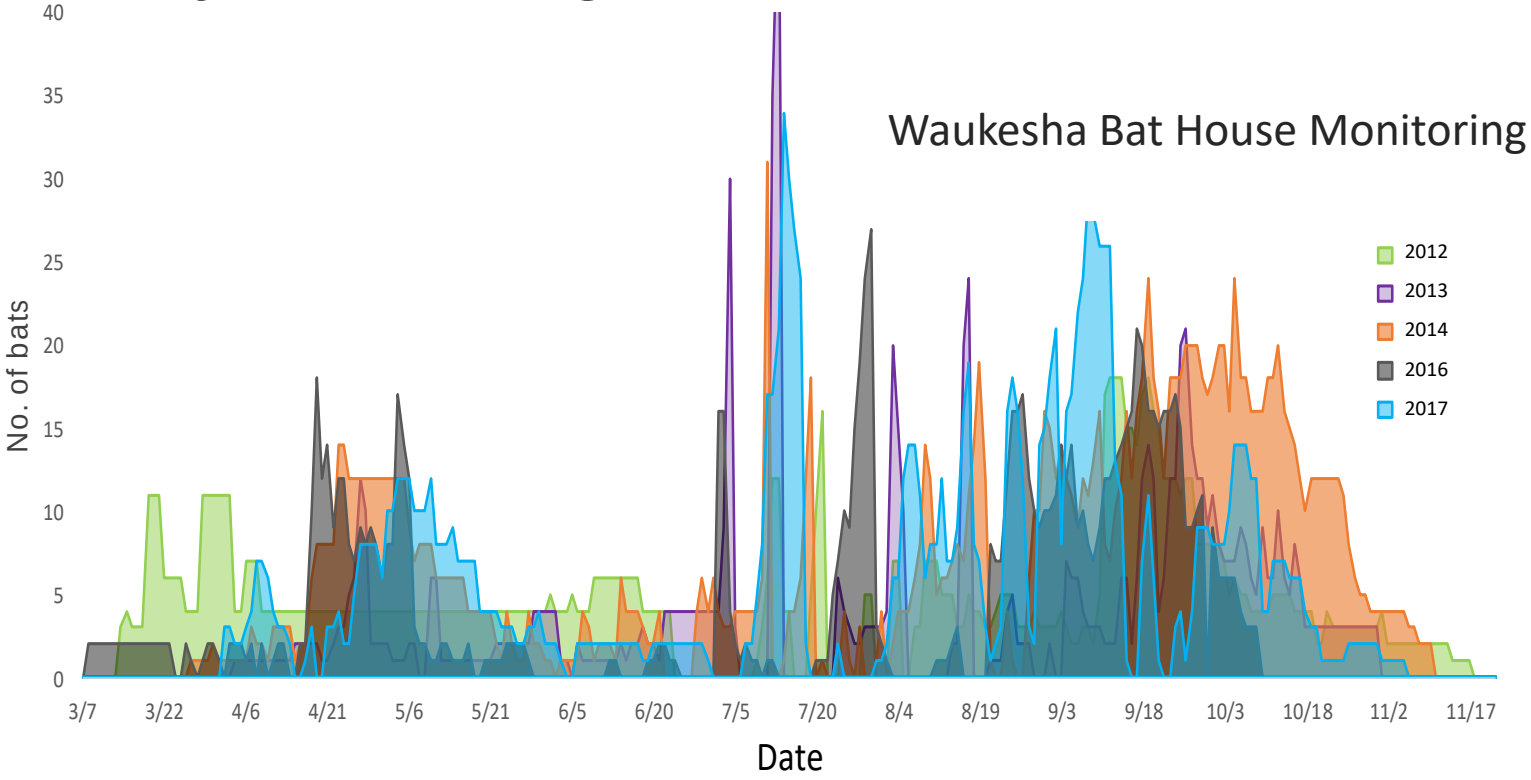
Bats using bridges as roosts is nothing new, but based on temperature requirements for reproductive females during maternity season, it was generally assumed that bridges in the northern part of the country were too cold to support large colonies of bats[3]. During a national survey of bridges in the 1990's in southern and western United States, biologists and engineers found 24 species of bats, including species found in Wisconsin, using bridges as day roosts[3]. In Wisconsin, biologists have known for some time that bats use bridges as night roosts because of the trapped heat under the structure, but our understanding of the use of bridges as day roosts just recently exploded with the discovery of an estimated 3,000 little brown bats using the I-90 bridge over the Mississippi River. The revelation that large colonies of bats are in fact using bridges during the day in Wisconsin spurred surveys across the state, and an additional eight significant bridge roosts have been identified. Most of these roosts are inhabited by little brown bats, but one is a mix of little brown bats and big brown bats, and one bridge houses a small colony of eastern pipistrelles. Both little brown and big brown bats are crevice and cavity roosters, so they prefer tight cracks. This means in bridges they roost in cracks in the concrete, or in the expansion joints located where the bridge meets the land. Eastern pipistrelles prefer to roost in the open, and when found under bridges are not in cracks, but usually clustered in open, domed areas that trap heat.

All of our known bridge roosts are over rivers, and the bats appear to require a certain size of bridge to make it worth while; the bigger the bridge, the higher the likelihood that it will have an expansion joint, and the more heat it will retain throughout the night.

For the past two years, we have worked closely with Wisconsin Department of Transportation to help identify bat roosts in bridges, and understand management requirements should road work need to be completed that may impact the roosting bats. Unfortunately, sometimes bats need to be removed from the bridge during demolition or modification projects, but we have had great success in maintaining the colony by timing projects to occur when bats aren't active and using bat houses as mitigation.

***Above left**: Little brown bats roost in the expansion joint of a bridge over the Mississippi River. **Above Right**: Eastern pipistrelles use the open space between support beams in La Crosse County to roost during the day.*

Daily monitoring



The above graph depicts counts conducted daily over the summers 2012-2014 and 2016-2017 at a single-chamber bat house housing big brown bats in Waukesha County. While big brown bats are known to periodically switch roosts over the course of the summer due to various factors such as ambient temperature, and parasite load[4], the daily monitoring of this roost in Waukesha County shows just how often big brown bats move among roost sites. The landowner and surveyor, Jim, has spent over 75 hours over the last six years monitoring his bats! When the number of bats displayed is zero, it means that zero bats were counted in the roost, not that no count was completed, with the exception of one week in late June 2016. Because of the difference in numbers of bats, even daily, inhabiting this roost, it is unlikely that this is a maternity roost since there are few bats present in June, and pups are difficult to move and carry after they reach a certain weight. There are likely several roosts in the area that these bats move between over the course of the summer.

With five years of monitoring, the graph begins to look muddy, but we continue to see a few trends stick out. The bats in this roost show up in late March or early April, and varies likely because of conditions (a cold spring can delay activity). The majority of the bats then leave the roost in late May. Though the timing of jumps in numbers doesn't exactly match every year, there are clear patterns of larger numbers of bats arriving in the second half of April and leaving in early May. Likewise, all years show a jump in population starting in late August, and most bats leaving in late September indicating this roost may be used as a migratory stopover for bats moving from winter to summer habitat and vice-versa. Curiously, there seems to be at least one brief, very large jump in bat numbers in mid– to late–July. The timing of this jump in mid-July lines up roughly with when we start to see juvenile big brown bats begin to fly. A hypothesis for the observed increase might be that juveniles are exploring and finding new roost sites during this time period. 2013 was a somewhat strange year where the bats didn't show up until late April and in low numbers compared to other years. During the population jump in July, 2013 experienced four sharp increases including on July 13th when the most bats ever were observed.

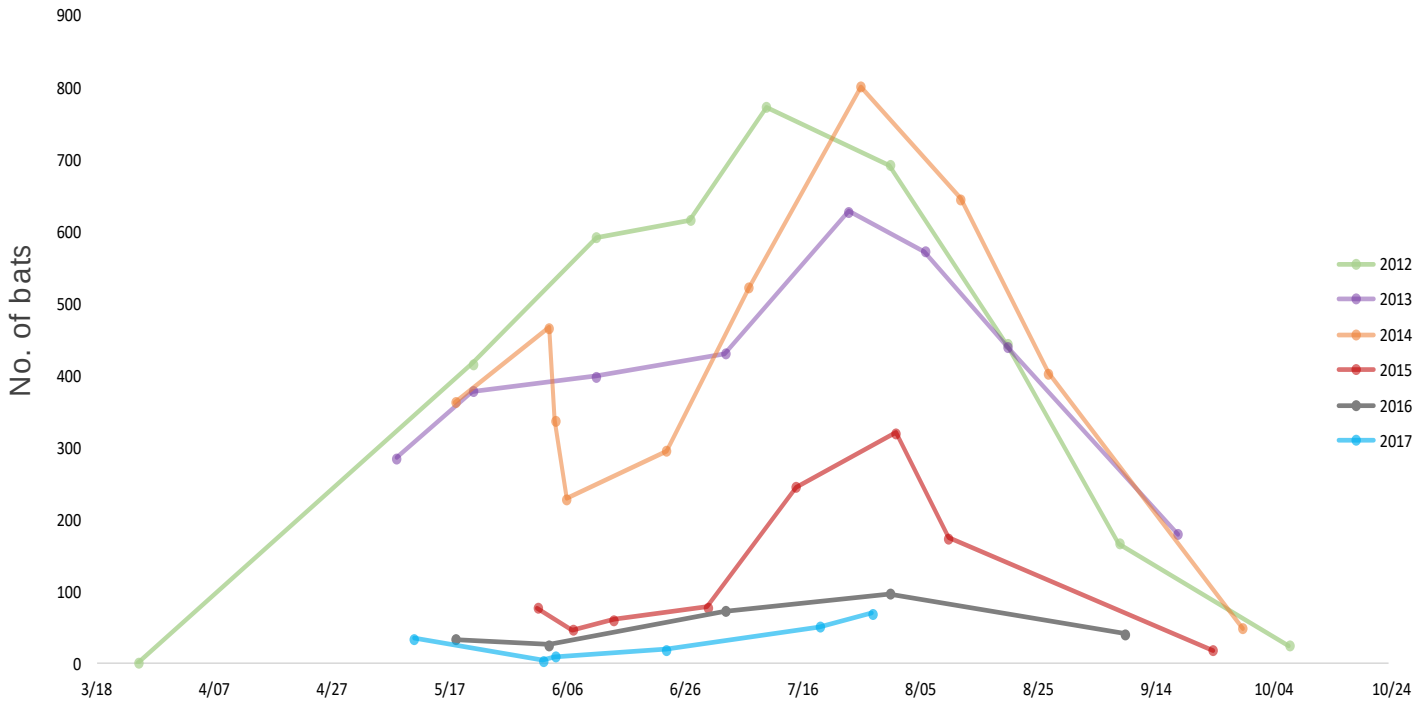
This survey effort has helped shine light into the secretive roosting habits of this species.

Impacts of white-nose syndrome

This graph below depicts counts conducted at a barn roost several times over the summer every year since 2012. This barn in Door County housed a significant population of little brown bats until the past three summers. Thanks to the efforts of volunteers, we were able to establish a baseline population prior to the arrival of WNS. For three years the population has been steady between 600 and 800 bats. In 2015 however, a significant decline was documented. In 2015, less than 20% of the normal population was counted until late July when the colony jumped in size to less than half of previous years' numbers. In 2016, the colony struggled to reach 13% of the average colony size in late July. This trend of ~50% decline one year and nearly 90% decline during the next year aligns with observations from biologists in the east[5]. This year the colony is at 8% of the highest counts, and ~10% of averaged high counts 2012-2015.

In the winter of 2013-2014, white-nose syndrome was confirmed in four counties in Upper Peninsula Michigan (UP), well within migration distances of little brown bats using summer habitat in Door County[6]. Typically, when WNS is first observed in a hibernaculum, few dead bats are found and significant population declines are not observed during the first winter of infection. Mortality and population declines are usually observed in the second and third years of infection. Because of the barn's proximity to infected hibernacula in the UP and Door County (infected in spring 2015), and the dramatic declines in population after WNS has been present for three years, we surmise that this is likely evidence of WNS impacts on the summer landscape.

Unfortunately, Door County is not the only area in Wisconsin to observe declines in summer populations presumably from white-nose syndrome. Most landowners with little brown bat roosts reported few or no bats return to their summer colonies this year. Yellowstone Lake State Park with its 30+ bat houses would routinely house over 3,000 little



Impacts of white-nose syndrome

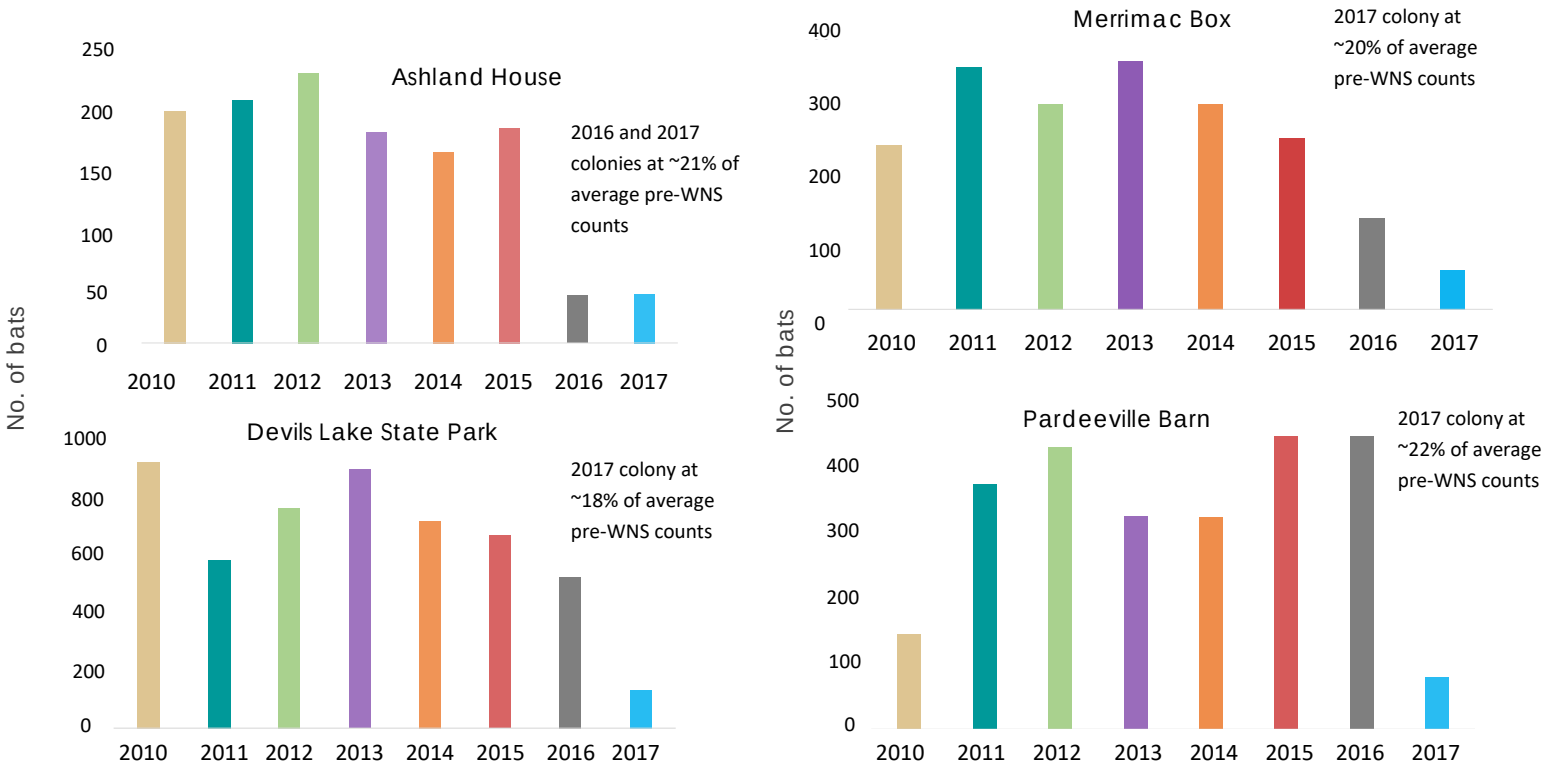
brown bats in summer. The highest count this year was 661, a decline of nearly 80%. Interestingly, several sites on the western edge of the state this year still had colonies within past, normal size ranges, indicating that the spread of WNS is moving east to west across the state, and possibly that bats are concentrating in areas with favorable foraging and roost habitat. Many colonies monitored yearly were at about 20% of average sizes pre-WNS. With smaller colony sizes in early summer, we also observed congregations of bats in smaller roosts (smaller bat houses for example), possibly because there weren't the numbers of bats needed to fill bat houses and maintain warm temperatures through clustering. As it became warmer throughout the summer, we observed bats moving among larger roosts.

With the exception of a few roosts in southern Wisconsin, all reported declines have been at little brown bat and eastern pipistrelle roosts. Big brown bats do not appear to experience the same declines from white-nose syndrome as little brown bats. There are still many questions to be answered about big brown bat roosting ecology before we can describe why drops in summer populations may be observed in this species.

A northern long-eared bat infected with white-nose syndrome in Crawford County.

Highest counts from multiple years

The below graphs depict the highest counts from a selection of sites where emergence surveys have been completed yearly. Some sites are counted only once a year, and even at different times of year so numbers may not always accurately represent the colony. These counts do, however, start to give us a look at long-term trends for colonies. Declines in these colonies hover around 20% of previous colony sizes, similar to when WNS declines were first documented in the Door County barn (previous page). Note the y-axis scale is different for each site. All graphs are from colonies of little brown bats.



How Wisconsin Bat Program uses information from volunteers

Reported and monitored bat roosts are important for furthering research and understanding of bats and white-nose syndrome in Wisconsin. Thanks to the efforts of volunteers and landowners, Wisconsin is unique and fortunate to have an established database of summer roost sites throughout the state which acts as a springboard for other important projects investigating bats and WNS in the state. This summer we were able to help coordinate and complete several projects at reported summer roost sites.

After guano is collected at bat roosts in southern Wisconsin, Amy extracts the DNA, and eventually sends it through a polymerase chain reaction (PCR) analysis to determine what the bats are eating.

- **University of Wisconsin-Madison project investigating bat diet and the importance of bats as pest control in the state.** Amy Wray, PhD student of Dr. Claudio Gratton and Dr. Zach Peery, is coordinating a project collecting guano and insect samples at summer roosts around southern Wisconsin. The guano will be analyzed genetically and the project will get a detailed look at diet of bats roosting in agricultural landscapes. The project selected all sites from reported roosts in WBP database and is scheduled 2014-2019, tracking colonies as WNS invades the state. Some of the participating landowners collect guano for Amy, while other sites get full surveys of bat activity, guano, and insect collections.
- **Banding bats at summer roost sites to recover marked individuals in hibernacula.** Little to nothing is known about the movements of bats between summer and winter habitat in Wisconsin. Because bats congregate in a small number of sites in winter, chances of recovery of bats that were marked on the summer landscape is thought to be high. To begin investigating bat movements, WBP selected 14 significant little brown bat colonies in the southwest portion of the state at which to trap and band. WBP banded over 1300 little brown bats were banded at these sites in 2015 and 2016. While trapping at the same sites in 2016, we recaptured 24 individuals (2.8% recovery rate), and we noted how well bats seemed to remember what occurred last year. To funnel bats into the trap, we set up tarps around the roost entrance so they must fly into the trap; however, bats at almost every site had ingenious ways of escaping beneath the tarps or avoiding the trap. This past winter we had our first summer to winter movement through our banding efforts! A male little brown bat banded at a Madison roost flew about 40 miles to a cave near Spring Green.
- **Investigating persistence of the WNS fungus at summer roost sites.** This summer, USGS collected guano and trapped bats at several roost sites in southern Wis-

How Wisconsin Bat Program uses information from volunteers

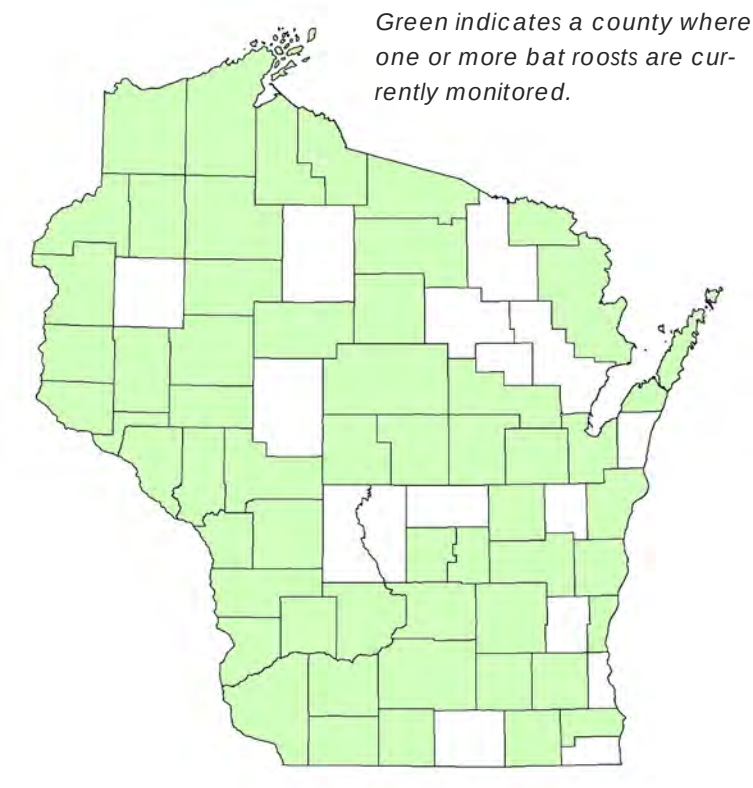

A small amount of fur is used to test whether or not the bat ingested the biomarker.

consin with the goal of determining how far into the summer season the fungus that causes white-nose syndrome (*Pseudogymnoascus destructans*, Pd) persists in bat roosts. In late May, early June and early July, we swabbed and banded captured bats for sampling, and USGS collected guano weekly to test for evidence of Pd. USGS is still in the process of testing swab samples and guano for genetic evidence of the fungus. One side note of this study was we found that the bats moved between the multiple bat boxes at the roost sites much more often than we thought.

- **Continued testing of vaccine application methods.** Researchers at USGS and UW-Madison continue to investigate possible vaccination for bats to prevent WNS infections. Part of vaccination includes determining best methods for administering vaccines to individuals. Last summer we worked with landowners at two little brown bat roosts in Dane County to test applying a biomarker directly to bats as they emerge from a roost. A portion of each colony was captured and treated with a topical biomarker. When the biomarker is ingested, it is visible in the hair follicles. We returned to the sites a week later to take hair samples from all individuals that we caught. All individuals treated had hair positive for the biomarker, but only one untreated individual was positive for the biomarker indicating that this species may not participate in mutual grooming as previously thought. We also hypothesized that this method did not work well because bats were treated as they left for the evening and may have groomed the biomarker off before returning to rub it off on colony mates. This year instead of applying the biomarker as the bats left, we treated the bat house with strips of biomarker gel in the early morning before the bats returned. At one site, about 60% of the bats captured had ingested the biomarker indicating that this might be a way to vaccinate bats against WNS in summer.

Continuing the Bat Roost Monitoring Project

Over the past eight years, volunteers and citizen-scientists have helped create an important database of bats roosts around the state. Each roost reported and emergence count completed helps create a better picture of summer bat roosting ecology in Wisconsin. The amazing efforts by landowners and volunteers are extremely valuable and we will continue monitoring current (and future!) roosts in the coming summers. WBP also continues aims to grow the summer bat roost database. Every year the number of monitored roosts grows and gives the WBP important information. The map at right shows each county where bat roosts are monitored in Wisconsin. If you know of a bat roost in a county lacking a monitored roost, or even in a county where bats are currently monitored, please feel free to report it!



Green indicates a county where one or more bat roosts are currently monitored.

Feedback from the Great Wisconsin Bat Counts continues to be positive, and WBP will continue this new tradition in the coming years. Even if volunteers are not able to participate in the Great Wisconsin Bat Counts, you are still encouraged to conduct emergence surveys each year. Each survey conducted adds to the growing database of baseline information about bat roost population trends across the state, and now as WNS invades. This critical information gathered by volunteers helps WBP investigate the full impacts of white-nose syndrome on bats in Wisconsin and helps inform recovery of bats post-WNS.

Little brown bats roost in a kiosk sign in Oneida County. Photo: K. Ortman

The bat roost monitored project is able to thrive because of the incredible work of volunteers and landowners. **We cannot thank everyone involved enough for their dedication and effort**.

I am constantly amazed by and thankful for the effort put forth by everyone who volunteers for the bat program, whether it be counting a roost or conducting an acoustic survey. It is truly magical to witness the excitement people have about bats and science, and I count myself very lucky to be a part of it. There is a long, hard road ahead with WNS finally in the state, but thanks to your efforts, we have made great strides in preparing for the disease. It may seem excessive, but thank you. We cannot continue the program without your help and support.

Heather Kaarakka
Bat Roost Project Coordinator

Heather Kaarakka removes a bat from a mist-net in northern Wisconsin.
Photo: Michael Kienitz

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Have questions about bats or roost monitoring? Feel free to contact Heather:
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608.266.2576

The Wisconsin Bat Program is part of the Bureau of Natural Heritage Conservation in Wisconsin Department of Natural Resources. The majority of Bat Program funding comes from grants and donations and much of our data is collected by volunteers. Thank you for your support.

399 surveys
were completed in 2017, counting
14,867 bats

Wisconsin Bat Program | Wisconsin Department of Natural Resources

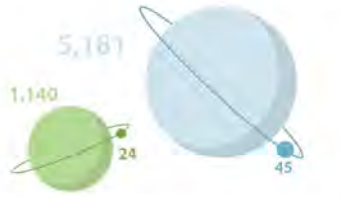
2017 Roost Monitoring Report

Great Wisconsin Bat Count

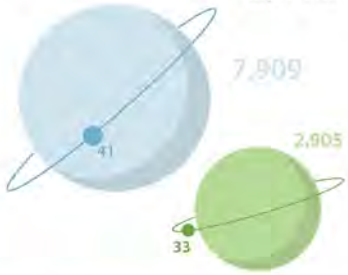
The goal was to count as many roosts as possible in a single weekend.

- Little brown bats counted
- Little brown bat surveys
- Big brown bats counted
- Big brown bat surveys

June 2, 2017



July 28, 2017



Building attics attract large crowds

Building attics and bat houses housed the largest numbers of little brown bats.

185 volunteers reached for their clicker-counters this summer to help count bats

Where do bats live?

The bats we count live in a variety of man-made structures.

Meet a couple of our bat species

Two bats that use artificial roosts in Wisconsin are the little brown bat and the eastern pipistrelle

Eastern Pipistrelle
Perimyotis subflavus

This little bat likes to eat caddisflies and beetles, and roosts in leaf cluters or open areas of buildings. In winter, pipistrelles hibernate in caves and mines.

Little Brown Bat
Myotis lucifugus

This common bat species eats small aquatic insects and roosts in bat houses and buildings in the summer. In winter, they hibernate in caves and mines.

A bat colony's summer

05 **May:** the roost colony population steadily grows as bats return to their summer roost from overwintering habitat.

06 **June:** most of the colony is present at the roost, and female bats give birth to flightless young.

07 **July:** bat pups born in June begin to fly in late July and the number of bats emerging from the roost increases.

08 **August:** adults begin migration back to winter habitat where they will mate throughout the fall.

Number of roosts counted in 2017

Big Brown Bat — **49** | **77** — Little Brown Bat

Help survey bats!

Know a place where bats roost? Want to help count bats?

Contact Heather at heather.kaarakka@wisconsin.gov or visit wiatri.net/inventory/bats

Produced by the Wisconsin Department of Natural Resources and the Bureau of Natural Heritage Conservation | 101 S Webster St, Madison, WI 53707 | DNRBureauofNaturalHeritageConservation@wisconsin.gov